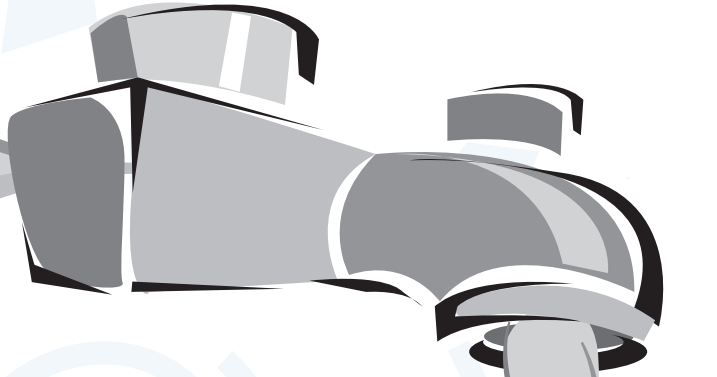
SECTION 6

FROM RIVER TO FAUCET



OUTCOME: WHAT STUDENTS WILL LEARN

- The water treatment process.
- Resources the Ohio River provides.
- The need for water treatment.
- The steps of the water treatment process.

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Core Content Standards

Science

SC-E-2.1.2 Earth materials provide many of the resources humans use. The varied materials have different physical and chemical properties, which make them useful in different ways.

SC-E-3.1.2 Organisms have basic needs. For example, animals need air water, and food; plants need air, water, nutrients, and light. Organisms can survive only in environments in which their needs are met.

SC-E-3.3.3 All organisms, including humans, cause changes in the environment.

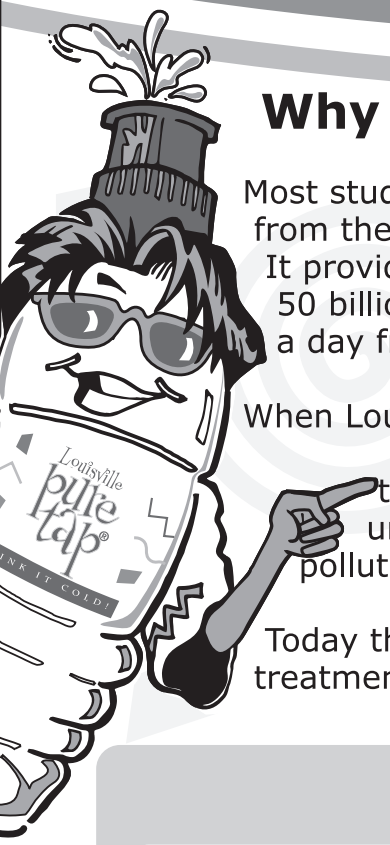
Practical Living

PL-E-3.3.2 To protect all citizens, there are community guidelines (e.g., school inspections, trash collections, water treatments, animal control, immunization) that promote healthy living environments in the community.

THIS SECTION:

- **Demonstrates the role science plays in everyday life.**

From River To Faucet



Why Treat It?

Most students will say "yuck" when you tell them their drinking water comes from the Ohio River. But we're lucky to have the Ohio River as a source. It provides us with an endless supply of water. On an average day, about 50 billion gallons of water flow by Louisville. We take about 127 million gallons a day from the river.

When Louisville Water Company first began in 1860 the river water was fairly clean. But as industry and towns grew, so did pollution. Until sewage treatment was developed, raw sewage was dumped into the river. And until lawmakers got tough on industry, many factories dumped pollutants and waste into the river.

Today the Ohio River is cleaner than it has been in 30 years. But it still needs treatment to turn it into drinking water.

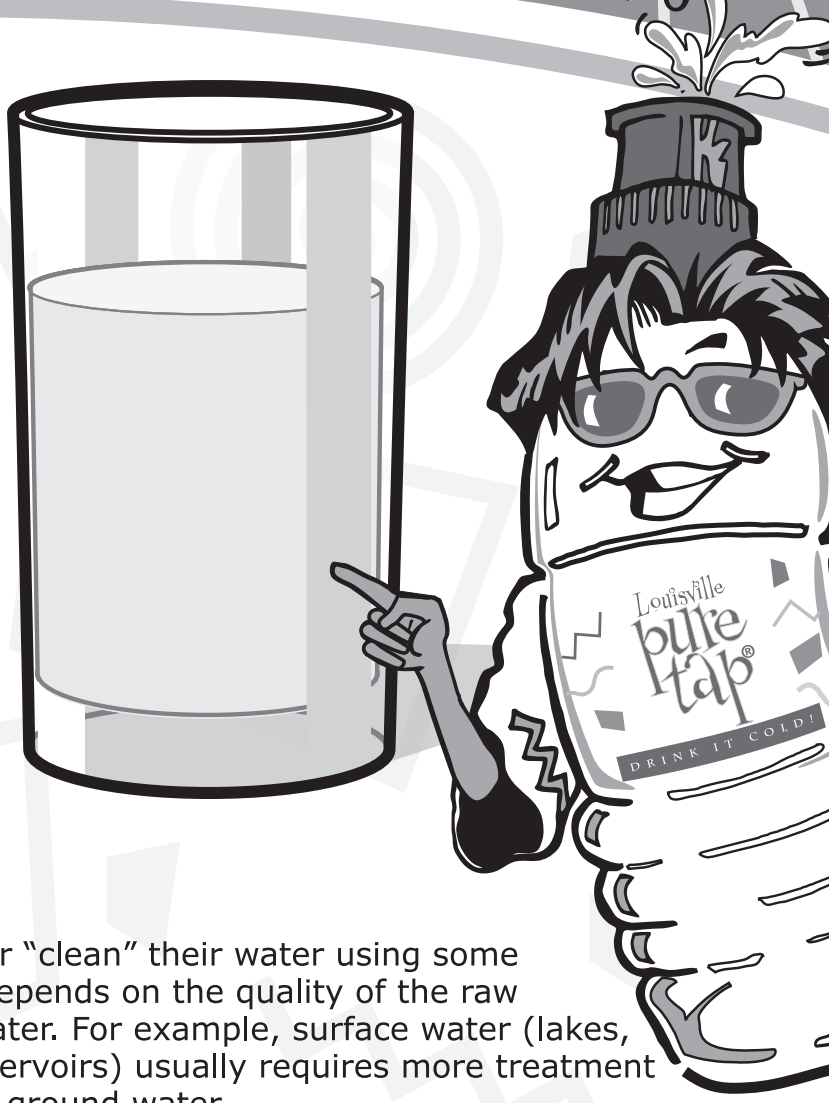
The Ohio River

The Ohio River begins in Pittsburgh, Pennsylvania and ends in Cairo, Illinois. It's the most industrialized river in the world with six states bordering it. 10% of the U.S. population lives in the Ohio River basin, and millions of people depend on it as a source of drinking water.

A Brief History

When Louisville Water Company first started in 1860, the only treatment was to let the sand and mud settle out of the water in the reservoir. Legend has it that sometimes you had to let a cup of water sit for a few minutes–so the remaining sand would settle to the bottom–then drink the water really fast!

By the late 1800's engineers at Louisville Water Company began doing experiments with filters and chlorine to disinfect and make the turbid (or cloudy) river water clean. Engineers here pioneered the work on filters that nearly every water utility uses.



Water Treatment

In the United States almost all cities treat or "clean" their water using some type of treatment process. Which process depends on the quality of the raw (untreated) water. For example, surface water (lakes, rivers and reservoirs) usually requires more treatment than ground water.

Louisville uses both surface and ground water. A majority of our water is surface water from the Ohio River. The ground water comes from the aquifer that sits along the river. Using a pump and well system, we take water from 70 feet under the ground. This water is much cleaner because it has passed through layers of sand and gravel. This process is called Riverbank Infiltration. (Section 8 deals with the **aquifer**.)

NOTE:

We recommend you teach sections 6, 7 and 8 together. They deal with different components of the water treatment process.

From River To Faucet

Louisville Water Company's Treatment Process

The treatment process at Louisville Water Company is outlined in the accompanying poster.

Louisville Water Company operates two treatment plants. The Crescent Hill Treatment Plant can handle up to 180 million gallons a day. The B.E. Payne Treatment Plant can handle up to 45 million gallons a day. B.E. Payne uses both surface water and ground water from a riverbank infiltration well.

Use these explanations and the treatment poster to show the water treatment process. (You received a large poster with the curriculum.)

Intake: Water is taken from the Ohio River through pipes that extend into the river. The pipes are about 15 feet under water. One of the pipes is 80 inches round. The water moves through a screen tower to remove large debris.

Reservoir: Electric pumps move the water to the **reservoir** where it settles naturally. Small particles of mud and clay that made it through the screen tower settle to the bottom.

Coagulation: Ferric chloride is for coagulation–that means bringing smaller particles together. The particles stick together to make larger particles called **floc**. The large particles are easier to remove.

Disinfection: We add **chlorine** and ammonia to form chloramine to disinfect the water.

Softening: We add lime to the water to adjust the hardness. **Hard water** refers to the mineral content (calcium and magnesium) of the water. In Louisville, our water is relatively hard to prevent lead from lead pipes in old homes from getting into the water.

Filtration: Water passes through a "rapid sand **filter**" made of coal, sand and gravel.

Fluoridation: Fluoride helps prevent cavities. Public water suppliers in Kentucky are required to add fluoride to drinking water. (Most bottled waters contain trace amounts of fluoride.)

Storage: The **clearwell**, a 25-million underground reservoir, holds the finished water.

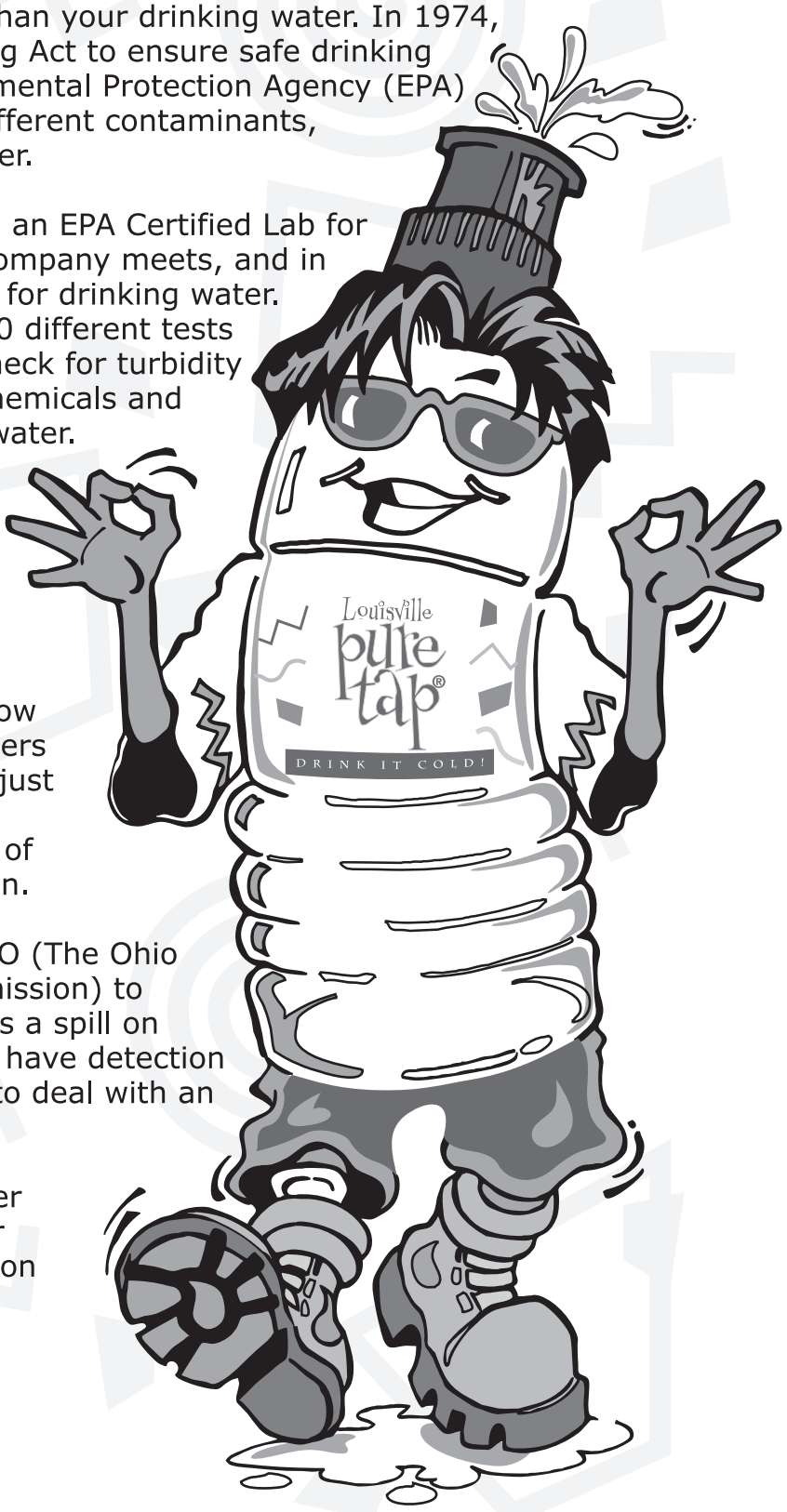
Pumping: Electric pumps help send the water to customers.

It takes approximately two days to make drinking water, but it can take up to a week to deliver the water, depending on where you live.

Making Sure it's Safe to Drink

There is nothing that's more regulated than your drinking water. In 1974, Congress passed the Safe Water Drinking Act to ensure safe drinking water in the United States. The Environmental Protection Agency (EPA) requires water utilities to test for 300 different contaminants, substances and qualities of drinking water.

At Louisville Water Company we operate an EPA Certified Lab for testing and research. Louisville Water Company meets, and in many cases exceeds, the EPA standards for drinking water. The chemists who work in the lab do 300 different tests on your drinking water every day. We check for turbidity (how clear the water looks), bacteria, chemicals and other contaminants that may be in the water. We also check the taste and odor and the pH of the water. (Our water has an average pH of 7.8.) We check the water that leaves our treatment plants and we test the water in the community at over 300 sampling stations.



In the spring of the year, we often find low amounts of pesticides in the river. Farmers often use atrazine on their crops. We adjust our treatment process for this. In the summer, we sometimes see an increase of algae in the water because of the hot sun.

We work with an agency called ORSANCO (The Ohio River Valley Water and Sanitation Commission) to monitor the river. This is helpful if there's a spill on the river. By working with ORSANCO we have detection points all along the river and are ready to deal with an emergency.

Every year our customers receive a water quality report. A copy is included in your teacher packet. Call the Public Information Office if you'd like copies of the current report for your class.

WATER WORDS

Aquifer: underground layer of rock or soil that holds water.

Chlorine: a chemical used as a disinfectant.

Clearwell: underground storage tank for drinking water.

Coagulation: process of bringing smaller particles together to form bigger ones.

Filter: something that strains things out or separates particles.

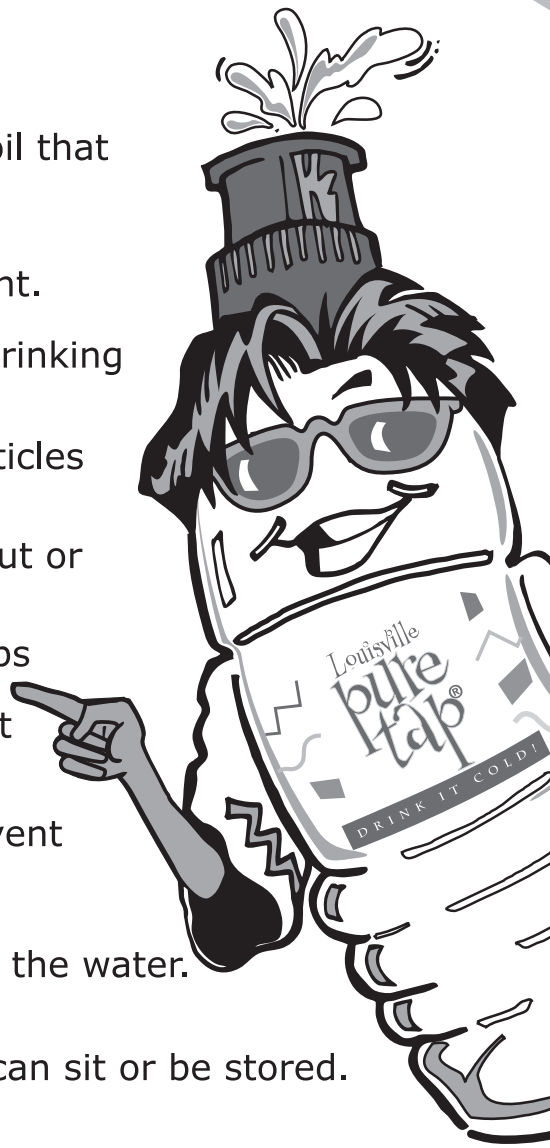
Floc: the result of coagulation. Clumps of particles that are easily removed in the water treatment process.

Fluoride: added to drinking water to prevent tooth decay.

Hard water: refers to the mineral content of the water.

Reservoir: a collecting point where water can sit or be stored.

Transmission mains: underground pipes that carry a large volume of water.



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Activity #1: Pure Tap Treatment Plant

Remind students Louisville Water Company also uses chloramines to disinfect the water. Therefore the water you just filtered is not safe to drink. Louisville Water Company also adds fluoride to the water to fight tooth decay.

Objective: Students learn how a water treatment plant works.

Time: One class period for instruction; 1 hour for the experiment.

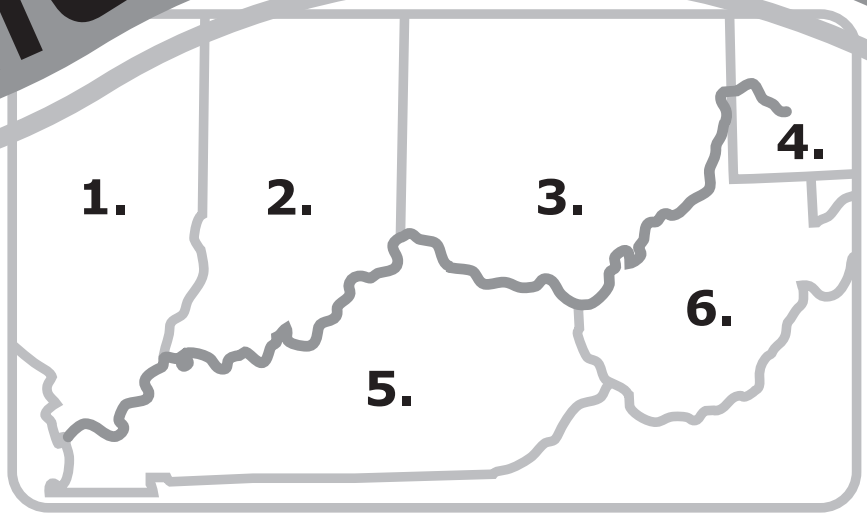
You'll need:

- "Swamp water" (Make about 4 liters of dirty water)
- 1 two-liter bottle with its cap
- 2 two-liter bottles – one bottle with the top cut off and one bottle with the bottom cut off
- Fine sand (marine or playground)
- 2 tablespoons of alum (potassium aluminum sulfate)
- Clock or watch with a second hand
- One large beaker
- Small pebbles
- 1 coffee filter
- Coarse sand
- 1 rubber band
- 1 large beaker or jar
- 1 tablespoon

Here's what to do...

1. Fill the two-liter bottle with its cap 3/4 full of the "swamp water." Have students describe the appearance and smell of the water.
2. Pour the swamp water into the bottle with its top cut off. Let the water sit for a few minutes. Watch what happens. This step represents **settling** – what the water does in the reservoir. You should see small particles in the water settle to the bottom.
3. Using the tablespoon add about two tablespoons of alum to the swamp water. Slowly stir the mixture for 5 minutes. This represents **coagulation** – the process where dirt and other suspended particles come together to form floc. This makes it easier to remove the particles from the water. Stirring the water represents coagulation. The alum is similar to the ferric chloride we add.
4. Allow the water to stand undisturbed in the bottle for about 20 minutes. Have students observe the water at 5-minute intervals. What happens to the water's appearance? This represents **sedimentation** – where the floc will form.
5. Now, make a filter. Use the bottle with its bottom cut off. Attach the coffee filter to the outside neck of the bottle with a rubber band. Turn the bottle upside down and pour a layer of pebbles into the bottle – the filter will prevent the pebbles from falling out of the neck. Pour the coarse sand on top of the pebbles. Pour the fine sand on top of the coarse sand (this represents the coal we use). Clean the filter by slowly and carefully pouring about 5 liters of clean tap water through the filter. Try not to disturb the top layer of sand. Make sure to have something to catch the water!
6. Now **filter** the swamp water. After a large amount of sediment has settled on the bottom of the bottle of swamp water, carefully – without disturbing the sediment – pour the top 2/3 of the swamp water through the filter. Collect the filtered water in the beaker.
7. Compare the "treated" and "untreated water." What do you notice?

WORKSHEET



The Ohio River is almost a thousand miles long! The river flows through or borders six states. List the states.

1. _____ 2. _____ 3. _____

4. _____ 5. _____ 6. _____

Explain why it's important for scientists to test the quality of both the Ohio River and the finished tap water. _____

_____

_____

What's the difference between surface and ground water? _____

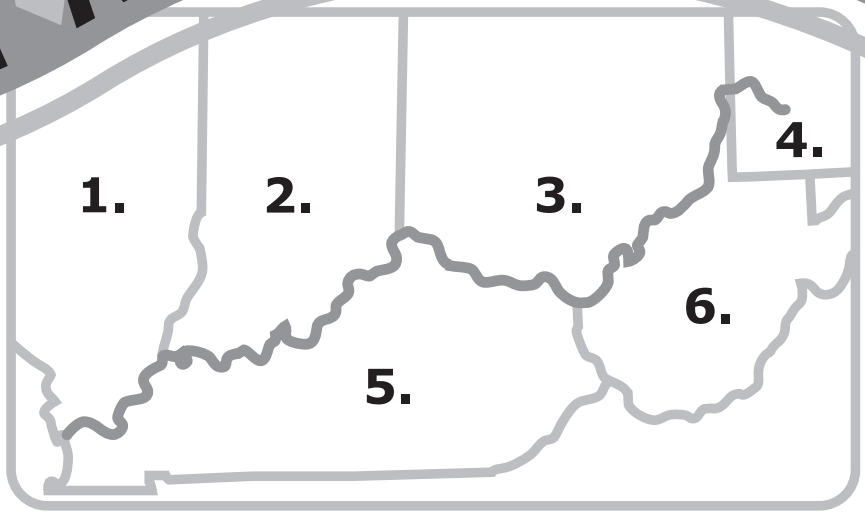
_____

_____

Match the water words to their definitions!

Aquifer	Refers to the mineral content of water
Chlorine	Something that strains things out
Clearwell	Underground layer of rock or soil that holds water
Coagulation	A collecting point where water can sit or be stored
Fluoride	Chemical used as a disinfectant
Floc	Bringing smaller particles together to form bigger ones
Filter	Underground storage tank for drinking water
Hard water	Pipes that carry water
Reservoir	Added to drinking water to prevent tooth decay
Transmission mains	The result of coagulation – clumps of particles

WORKSHEET ANSWERS



The Ohio River is almost a thousand miles long! The river flows through or borders six states. List the states.

1. *Illinois* 2. *Indiana* 3. *Ohio*
4. *Pennsylvania* 5. *Kentucky* 6. *West Virginia*

Explain why it's important for scientists to test the quality of both the Ohio River and the finished tap water. *It's important to test the source to determine if we need to adjust the treatment process. It's important to test the finished product, the tap water, so the water is safe and clean to drink. We must make sure the water meets the strict standards set forth by the EPA.*

What's the difference between surface and ground water? *Surface water comes from rivers or lakes. Ground water is just that – water that comes from the ground. Louisville gets its water from both surface water (Ohio River) and ground water (Riverbank infiltration well)*

Match the water words to their definitions!

Aquifer	Underground layer of rock or soil that holds water
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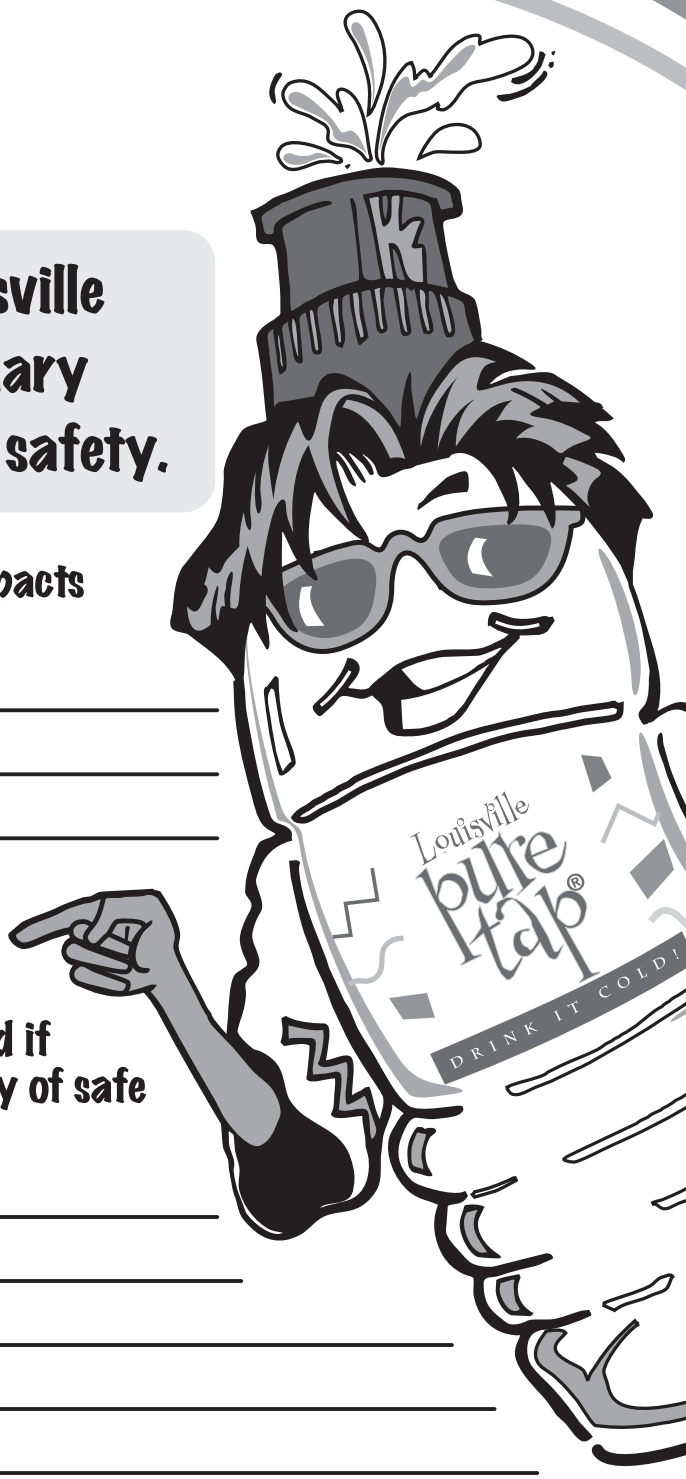
Open Response Question

A public water utility, like Louisville Water Company, has two primary responsibilities: public health and safety.



A. Give an example of how a water company impacts public health and safety.

B. Explain how your examples could be impacted if the water company did not produce a good supply of safe drinking water.

Open Response Question

A. Give an example of how a water company impacts public health and safety.

B. Explain how your examples could be impacted if the water company did not produce a good supply of safe drinking water.

Scoring Guide

4– Student gives an example for health and safety and has a clear understanding of a water company's impact on both.

3– Student gives an example for health and safety but has a limited understanding of a water company's impact.

2– Student answers part A but not B. OR Student gives examples for either health/safety and an explanation for the impact.

1– Student gives a partial answer for A only.

0– No response.

Look for:

- safe drinking water important for a person's health, water is used to grow and make food, fire protection, hospitals, etc.

From River To Faucet

Check out these opportunities to keep the learning flowing!

Extra, Extra!!

Books:

Coll, J. (1986). *The magic school bus at the waterworks.* New York, NY: Scholastic.

Seuling, B. (2000). *Drip, drop, how water gets to your tap.* New York, NY: Holiday House. *Literature and experiments.*

Symons, J., (1999). *Plain talk about drinking water.* Denver, CO: American Water Works Association. *Book answers common questions about drinking copy. Available on loan from Louisville Water Company.*

Web sites:

http://water.nr.state.ky.us/dw *Information on Kentucky's water supply.*

http://drinkingh2o.com/html/slides/d101-1.htm *On-line slide presentation of a water treatment process.*

www.epa.gov/owow/monitoring/nationswaters/ *Printable workbook that examines the quality of our nation's water. Appropriate for grades 5-7. Includes reference information and experiments.*

www.eddiefiles.org/mathtrails/nycwater *Learn about how the New York City Water Company works.*

www.epa.gov/OGWDW/kids/wsb/index.html *Additional curriculum regarding water treatment.*

www.orsanco.org Information on the Ohio River.

Louisville Water Company Opportunities:

www.tappersfunzone.com Click on "Where's the Water" for an animated look at water treatment. Invite an LWC scientist to your class to talk about water quality. Call the Public Information Department at 569-3600. The Public Information Department can also give you information about other learning opportunities.

Water Works- A 45 minute document highlighting the history of LWC.